

REMARKS

The Claims

As a preliminary matter, the Applicant notes that the Office Action Summary states that Claims 1, 17, and 26 are allowed and that Claims 2-16, 18-25, and 27-34 are rejected. However, the body of the Office Action clearly indicates that Claims 1, 17, and 26 are rejected and that Claims 2-16, 18-25, and 27-34 are allowed. Accordingly, it is believed that the status of the claims set forth on the Office Action Summary sheet is incorrect.

35 USC § 102: Claims 1 and 26

The Examiner rejected Claims 1 and 26 under 35 USC § 102(b) as being anticipated by WO 94/28300 (Orbital). In making that rejection, the Examiner stated:

Figure 1 shows delivering products of combustion via lines 7-9 from a cylinder in its expansion stroke to the next cylinder in its compression stroke. Typical engines have the air and fuel already mixed. The term 'elevated' is relative, and the exhaust is under elevated temperature and pressure relative to the mixture in the compression cylinder.

The Applicant respectfully disagrees with this rejection.

Claim 1 reads as follows.

1. A motor comprising: an engine block with three or more cylinders arranged to fire with a firing order; a fuel injector associated with each cylinder; and a recirculation system comprising fluid transfer paths which are arranged to provide a fluid connection between cylinders sequentially in the firing order of the motor, the motor configured such that combustion in a cylinder creates a combusted mixture having a combustion pressure, **which combustion pressure forces some of that combusted mixture to at least partly mix with fuel for the next cylinder in the firing order to improve the combustion properties of the fuel, and to deliver a mixture of the combusted mixture and fuel under elevated temperature and pressure into said next cylinder in the firing order.** (Emphasis added.)

Orbital does not teach or suggest the Applicant's claimed motor as set forth in Claim 1. Orbital describes a system having a plurality of cylinders with pistons. Within each cylinder, a

port A is provided above the exhaust port 10 in the cylinder, and is connected via a transfer passage 7, 8, or 9 to the next cylinder in the firing order via a port B. In the operation of the engine described in Orbital, exhaust gas transfers through port A before exhaust is exited from the exhaust port 10. The inlet port B in the cylinder is open while the exhaust port and transfer port in the next cylinder are open, but closes before the exhaust port and transfer port close. In the Applicant's claimed motor as set forth in Claim 1, the combustion pressure forces some of the combusted mixture to at least partly mix with fuel for the next cylinder in the firing order, and to deliver that mixture into the next cylinder in the firing order. That is, the Applicant's claimed motor provides premixing of combusted mixture from a previous cylinder and fuel, and delivers the mixture of combusted mixture and fuel at elevated temperature and pressure into the next cylinder in the firing order. The Orbital system does not pre-mix combusted mixture with fuel prior to delivery into the cylinder. In the Orbital system, the mixing of the combusted mixture and fuel occurs within the cylinder.

Orbital does not show or describe the location of any fuel injector(s). Therefore, it is presumed that air and fuel are delivered directly into the cylinder via the intake ports such as transfer ports 11, 12 as in a standard two-stroke motor. However, as a result of such operation, the mixture of air and fuel would be provided into the combustion chamber at a significantly lower temperature than the exhaust gas from the previous cylinder. The only mixing of combusted mixture and fuel in the Orbital system occurs in the cylinder.

In the Applicant's claimed motor, the combusted mixture is pre-mixed with the fuel and delivered to the combustion chamber at the elevated temperature and pressure from one cylinder to a following cylinder. With the Applicant's claimed arrangement, the combustion properties have been found to improve. The combination of the combusted mixture and fuel slows the flame travel and retards ignition in the next cylinder in the firing order. That enables higher compression ratios to be used with heavy fuels such as diesel hydrocarbon fuel, with reduced 'knocking' or auto-ignition. Therefore, lean mixtures can be used to obtain high power output. Further, the elevated temperature and pressure of the combusted mixture 'picks up' the fuel and atomizes the fuel prior to its delivery (in combination with the combusted mixture) into the

cylinder, improving combustion properties for that cylinder. This is particularly useful when using heavy fuels such as diesel.

Since the system described in Orbital does not pre-mix fuel with the combusted mixture before delivery into the cylinder, the temperature of the mixture is significantly lower. The result is that the benefits provided by the Applicant's claimed motor are not realized by the Orbital system. Additionally, the Orbital system teaches away from utilizing elevated temperature. For example, lines 3-10 of page 5 state:

In order to assist in increasing the mass of combusted gas supplied to the respective cylinders, it is preferable that during the passage from one cylinder to another, **the combusted gas is subject to a degree of cooling**. This may be achieved by locating the gallery or the passage containing the combusted gas adjacent the cooling system of the engine and/or by providing specific cooling to the passages, ducts or galleries, by cooling means such as cooling fins on the periphery thereof, or a specific jacket through which a cooling medium such as water or air is passed. (Emphasis added.)

For all of the foregoing reasons, the Applicant submits that Claim 1 is novel and inventive over Orbital.

The Applicant's claimed method as set forth in Claim 26 includes the step of delivering the combusted mixture at combustion pressure and temperature from a cylinder which has just fired to at least partly mix with fuel for the next cylinder in the firing order to improve the combustion properties of the fuel, and the step of delivering a mixture of the combusted mixture and fuel at elevated temperature and pressure into the next cylinder in the firing order. That is, the method claim is also limited to pre-mixing of the combusted mixture and fuel, before delivering that combination into the next cylinder in the firing order. For the reasons discussed above relative to Claim 1, the steps of the Applicant's claimed method as set forth in Claim 26 are not taught or suggested by Orbital. Therefore, the Applicant's claimed process as set forth in Claim 26 is novel and inventive over Orbital.

35 USC § 103: Claim 17

The Examiner rejected Claim 17 under 35 USC § 103(a) as being unpatentable over Orbital. In making the rejection, the Examiner stated:

To apply the method of delivering exhaust gas from a cylinder during its expansion stroke to the next firing cylinder, that would be in its compression stroke, to any engine, including an axial engine would have been obvious to one of ordinary skill in the art, so as to reduce emissions.

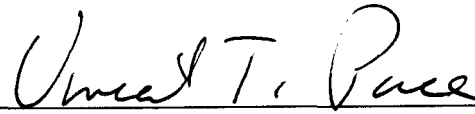
Claim 17 depends from Claim 1 and thus, includes all of the features set forth in Claim 1. Therefore, the Applicant's claimed motor as set forth in Claim 17 is novel and inventive over Orbital for at least the same reasons as Claim 1. Additionally, the Applicant's claimed motor as set forth Claim 17 is configured as an axial motor. A benefit of using the claimed configuration in an axial motor is that the fluid transfer paths between adjacent cylinders in the firing order can each be substantially the same length, which results in easier management of the timing of the system. That advantage is not readily available with the Orbital system because the Orbital system is structurally and functionally different from the Applicant's claimed motor.

CONCLUSION

In view of the foregoing amendments and remarks, it is believed that the claims currently pending in this application are in condition for allowance. The Applicant respectfully requests that the Examiner reconsider the application in the light of the amendments and remarks presented herein.

Respectfully submitted,

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